Mr. Taylor has a thorough knowledge of his business, and is thereby able to appreciate all the difficulties that are inherent in contract work. He is firm and just in the control of his large staff, and whilst he is not one to overlook "any slackness" that comes under his notice, he is always ready to offer a word of praise for work well done.

He is a thorough believer in a word of encouragement at the ight time, and has deservedly won not only the respect of his own staff but of all that have been brought into business relations with him. With his colleagues he is on the friendliest terms, and he enjoys to the full the confidence of his chiefs.

Mr. Taylor confesses to no particular hobby. Gardening, however, has a great fascination for him, the growing of roses being his speciality. Walking is his recreation, and when not engaged in this healthy pursuit he devotes most of his spare time to reading, of which he is extremely fond.

LONG-DISTANCE TELEPHONY.

By J. J. Carty.

[Mr. Carty, Chief Engineer of the American Telephone & Telegraph Company, made the following remarks on this subject at the second International Conference of European Telegraph and Telephone Administrations (held at Paris).]

Mr. President and Gentlemen,—I think that my contribution to this discussion can best take the form of a general statement, setting forth some points with respect to the condition of long-distance telephony in the United States.

The present state of the art with regard to long-distance telephony in the United States involves the use of two gauges of copper open wire toll lines—namely, No. 12 N.B.S.G. (2·64 mm.), weighing 173 lbs. per wire mile (42·3 kos. per km.), and No. 8 B.W.G. (4·2 mm.), weighing 435 lbs. per wire mile (122·6 kos. per km.), and the use of underground and aerial toll cables with conductors varying in size from No. 16 B. and S. (1·3 mm.), 42 lbs. per wire mile (11·8 kos. per km.). to No. 13 B. and S. (1·8 mm.), 83 lbs. per wire mile (23·4 kos. per km.) paper insulated twisted pairs. The open wire circuits are both loaded and non-loaded, and the non-loaded circuits are frequently used in conjunction with telephone repeaters, both of the test board and cord circuit type. The cable circuits used in connection with long-distance telephony are invariably loaded.

In addition to the use of physical circuits there is a great deal of phantoming of non-loaded open wire toll lines. Cable circuits are phantomed to but a small extent however.

In addition to the foregoing, which are in actual commercial use, the development at present taking place in connection with long-distance transmission, contemplates the use of larger gauge loaded cable circuits arranged for phantoming and the phantom working of loaded open wire toll lines. These points are taken up under the separate headings below.

Open Wire Toll Lines.—At the present time the standard of transmission aimed at for long-distance work is the equivalent of about 850 miles of No. 8 B.W.G. (1,360 kms. of 4·2 mm.) copper circuit (about 30 miles of No. 19 gauge cable—48 kms. of 0·9 mm.) The exact distances for which it is permissible to use the different classes of constructions depend to a considerable extent on the terminal conditions, that is the amount of underground toll entering cable and the uses to which the circuit is to be put; for example, whether it is largely for terminating business or is to be used mainly in connection with other circuits. The following table shows the relative transmission efficiences of the different classes of non-loaded and loaded circuits at present employed :—

Open wire circuit.	Miles equivalent to 1 mile No. 19 B. and S. cable (0·054 mf.).	Relative efficiency.
No. 12 N.B.S.G. (2·64 mm.) non-loaded	12·8	1·00
" " " loaded ...	30·2	2·36
No. 8 B.W.G. (4·2 mm.) non-loaded ...	29·0	2·26
" " " loaded ...	67·0	5·23

In general the No. 12 N.B.S.G. (2·64 mm.) circuits are used for the short haul toll connections or as feeders for the long haul toll circuits, that is for connecting the terminal points to toll centres which have long haul facilities. The No. 12 N.B.S.G. (2·64 mm.) loaded circuits and the No. 8 B.W.G. (4·2 mm.) non-loaded circuits are used for long haul toll lines. As the above table shows, these two circuits have approximately the same transmission efficiency, and the principal reason why there are any non-loaded No. 8 B.W.G. (4·2 mm.) circuits in the plant at the present time is due to the fact that, in the days before it was feasible to load open wire circuits, the No. 8 B.W.G. (4·2 mm.) wires were universally used for long toll lines. Owing to the inherent characteristics of loaded lines the loading of large gauge aerial circuits was not made practicable until very recently. As fast as the present plans can be carried out all of the No. 8 B.W.G. (4·2 mm.) circuits now in the plant, and certain other circuits which will be required to take care of the long-distance traffic, are to be loaded. This new loading contemplates the arrangement of the circuits for phantom working. When this is completed the loaded No. 8 (4·2 mm.) gauge circuits, both physical and phantom, will constitute what might be termed "extra long haul" circuits.

Aerial Loading.—At the present time there are about 52,000 miles (83,500 kms.) of loaded No. 12 N.B.S.G. (2·64 mm.) circuit in the United States, and about 1,000 miles (1,600 kms.) of No. 8 B.W.G. (4·2 mm.) loaded circuit. There are at present under construction, or intended for completion by Jan. 1, 1911, about 17,000 miles (27,200 kms.) No. 12 N.B.S.G. (2·64 mm.) loaded circuit, and about 13,000 miles (21,000 kms.) of No. 8 B.W.G. (4·2 mm. loaded circuit. Of this latter about 3,800 miles (6,100 kms.)—namely, four circuits from New York to Chicago—will be arranged for phantom working.

The efficiency of these two phantom circuits from New York to Chicago is expected to be substantially greater than the physical circuits of which they are composed. Either of these two phantom circuits may be connected at Chicago to a pair of loaded No. 8 B.W.G. (4·2 mm.) wires extending from Chicago to Omaha. At Omaha these two wires may be connected to a phantom circuit made up of four loaded No 8 B.W.G. (4·21 mm.) wires, now being constructed between Omaha and Denver. Over this combination of circuits it is expected, about Jan. 1 next, that we shall be able to get a fairly good talk between New York City and Denver, Colorado, and that, by means of this and similar combinations of circuits, the value of the transmission obtained between New York and the far Western cities will be very greatly increased. Over these circuits—or over sections of them—it is proposed to operate in the standard manner each wire for the purpose of duplex telegraphy which can be carried on over these wires while they are being used for telephone purposes. Thus we may have going on at the same time two independent and non-interfering telephonic conversations between New York and Chicago, also two independent and non-interfering telephonic conversations between Omaha and Denver. In addition to this, a third conversation may take place—at the same time and over the same wires—between Denver and New York. While all of these telephonic conversations are taking place, eight (8) telegraphic messages may simultaneously be sent over these circuits, none interfering with the others nor with the telephone transmission.

Some idea of the economic importance of this loading and phantom work may be gained when I state that the re-arrangement of the circuits on the new plan between New York and Chicago is being accomplished at a cost of $110,000 (frs. 572,000). The improvement in efficiency in the transmission of speech thereby obtained and the additional improved circuit which phantoming gives to us would cost more than a million dollars ($1,600,000) (frs. 8,320,000) if obtained in the ordinary way.

With the loading coils and lightning arresters as now constructed, there is very little trouble due to the failure of the loading coils, and practically no trouble due to low insulation in the arresters. These latter are also constructed in such a manner that there is practically no maintenance on them.

In the early attempts to load serial circuits one of the chief difficulties arose from inability to protect the loading coils from lightning with an arrester which did not require an excessive amount of attention, and it was largely for this reason that the early attempts at aerial loading were a failure.

At the present time the chief trouble on loaded circuits has been occasioned by low insulation due to leakage at the bridling points. This has been corrected by the adoption of the bridle wire electrose insulator, which insures a break in the conducting path along the wet bridle wire.

Phantoming.—The phantoming of non-loaded circuits involves the use of phantom repeating coils on the component side circuits. These coils necessarily introduce a certain amount of transmission loss so that the efficiency of the side circuits is slightly reduced. The phantom circuit produced is, however, considered more efficient than the original side circuits, and where phantoming is adopted in the toll plant it is usual to arrange the traffic so that the long haul connections will be put up on the phantom and the shorter haul connections on the side circuits.

Loaded Phantoms.—By properly arranging the windings on the loading coil cores, by observing extraordinary precautions in the manufacture and by constructing special coils arranged for four sets of windings, it is possible to phantom loaded circuits and to load the phantom thus produced. The impairment in the efficiency of the loading side circuits due to the introduction of the phantom loading coil is slight, and the loaded phantom has materially higher transmission efficiency than either of the side circuits.

By the adoption of this phantom loading, the preliminary work on which is just being completed, one of the chief drawbacks to the extensive use of aerial loading will be overcome, and at the same time the range of transmission will be considerably increased. The limitation to loading which has existed in the past due to inability to phantom the loaded circuits has been due to the fact that it has been necessary to choose between the economies of phantoming with practically no increase in the transmission range, or to load the physical circuits thus extending their transmission range and to provide additional physical circuits to care for increased traffic. With phantom loading both benefits will be available.

Superimposed Telegraph.—All of the long-distance toll lines are used for superimposed telegraph working. This applies also to phantom circuits.

Both simplex and composite combinations are in use. Both involve grounded telegraph operation. In the first of these the two wires of a pair are used in parallel as a telegraph conductor, and in the second each wire is used as a separate telegraph circuit. Straight and duplex Morse working are in vogue, and while automatic keys are used to a considerable extent, there is no present operation of high speed machine sending. The loading of circuits does not interfere in any way with their applicability for telegraph purposes except that it places a limitation on the maximum value of the telegraph current—*i.e.*, it is not possible to employ such currents as will magnetise the loading coil cores.

Cable in Connection with the Long-Distance Telephone Service:—Paper insulated cables are employed for two purposes in connection with the long distance telephone plant (this does not include the use of cables for toll-switching trunks) The first of these is for bringing open wire toll lines into the centres of cities where it is not possible to install and maintain open wire leads, and the second is for use between large toll centres where the volume of terminating traffic is such as to require a large number of circuits. Under these conditions it is economical to instal underground toll cables for very considerable distance.

For both classes of service the cables are invariably loaded.

Toll Entering Cables.—Cables for toll entering purposes range in size from No. 16 (1·3 mm.) to No. 13 B. and S. (1·8 mm.) gauge conductors, depending upon the character of the open wire toll lines and are the loaded, light, medium or heavy, depending upon their length, upon whether the open wires are non-loaded or loaded and upon whether the toll switching trunks are non-loaded or loaded. As the number of circuits in the toll entering cables is always in excess of the number of toll lines to be brought in, considerations of the warranted expenditures for a given transmission gain result in the cable conductors being somewhat smaller than those of the open wire lines which they are to serve. In determining the proper gauge of any toll entering cable, this cable is so arranged as to be in cost-equilibrium with the open wire plant which it is to serve.

Duplex Cables.—At the present time practically all of the toll entering cables are of ordinary construction, that is, not arranged for phantom working. Duplex cables and proper loading coils for use on them have recently been devised and are being installed. The employment of such cables will make it possible to employ phantoming of the open wire plant to full efficiency, as it will remove the necessity of placing the phantom repeating coils on the outer end of the toll entering cable by permitting the phantom circuits to be carried into the toll office as such, thus making all the wires available for composite operation.

Toll Cables.—Between certain large cities—for example, between New York and Philadelphia, New York and New Haven, Chicago and Milwaukee, Boston and Worcester, Boston and Brockton - the volume of traffic is sufficient to warrant the provision of special high-grade loaded cable circuits in underground conduit. At the present time these circuits are in cables of ordinary construction, that is, not arranged for phantom working, and are usually provided with heavy loading. To provide the necessary transmission efficiency the cable conductors for the long haul circuits are usually No. 14 (1·6 mm.) or No. 13 B. and S. (1·8 mm.) gauge. A certain number of smaller gauge conductors for service to intermediate points are frequently incorporated in the same cable sheath. The standard full-sized sheath is $2\frac{5}{8}$ inches (66 mm.) outside diameter and the sheath thickness is $\frac{1}{8}$ inch (3·2 mm.). The paper insulated conductors have a mutual electrostatic capacity of about ·068 mf. per mile (·042 per km.).

In cases of this kind, where a large number of circuits are provided in a single sheath, special rapid operating methods are in vogue. The circuits are also employed for superimposed telegraph working.

Extension of Underground Working.—At the present time we are preparing to install an all underground cable route from New York to Washington, a distance of 235 miles (378 kms.), and from New York to Boston, a distance of 235 miles (378 kms). The cable in these routes is to be of special duplex construction, that is, arranged for phantom working and both the side circuits and the phantom circuits are to be loaded. The cable will be of standard size and will contain seven quads No. 10 B. and S. (2·6 mm.) conductors, eighteen quads No. 13 B. and S. (1·8 mm.) gauge conductors, six pairs of No. 13 B. and S. (1·8 mm.) gauge conductors unphantomed, and eighteen pairs of No. 16 B. and S. (1·3 mm.) gauge conductors unphantomed. The loaded No. 10 (2·6 mm.) gauge physical and phantom circuits and the loaded No. 13 (1·8 mm.) gauge phantom circuits will give a high grade of transmission from New York to Washington or Boston, and the No. 13 (1·8 mm.) gauge loaded side and non-phantomed circuits will give transmission to intermediate points. No. 16 (1·3 mm.) gauge conductors will be used for short haul service along the route and for telegraph operation.

It will be seen that over the circuits of this cable phantom working will be accomplished, superimposed telegraph working will also be used, so that over two pairs of wires three independent telephone conversations may take place simultaneously, and at the same time eight telegraph messages may be sent, all without interference.

Phantom Loading Coils.—With the standard coils now in use it is not possible to secure efficient phantom working. The coils have, however, been re-designed to eliminate this difficulty, and in the future all coils are to be manufactured so that they may be employed on duplex cable. In the case of the New York to Washington and New York to Boston cables the associated side circuit and phantom loading coils will be mounted in the same pots, all of the cross-connecting being done at the factory. The plant force will, therefore, have simply to connect the stub cable into the main cable.

Certificate for Saving Life.—Mr. C. A. Bevan, Cashier in the district office, Swansea, who assisted in rescuing a young lady from drowning at Langland Bay, near Swansea, about three months ago, is the recipient of a certificate recording his gallantry. The presentation was made by the Mayor of Swansea at the Guildhall in that town.